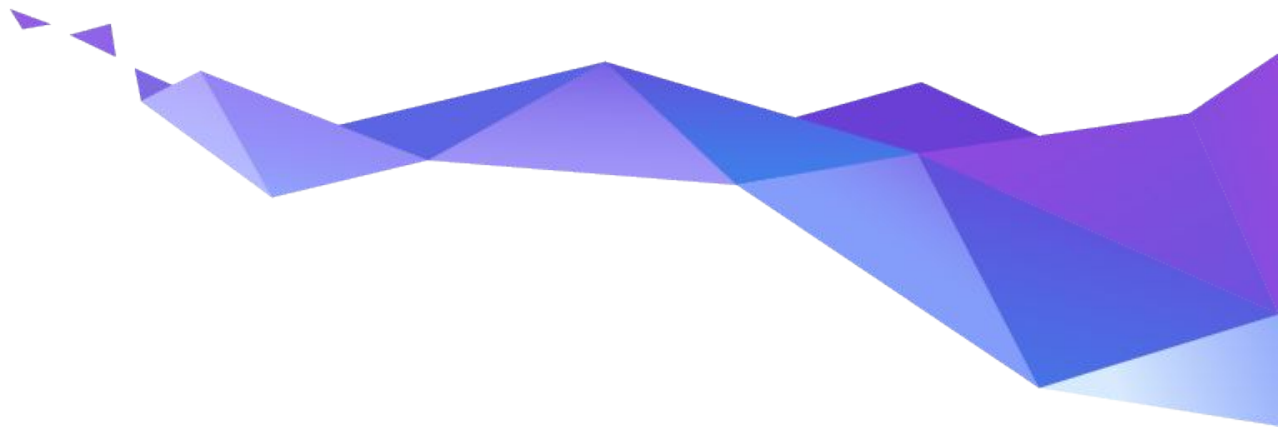
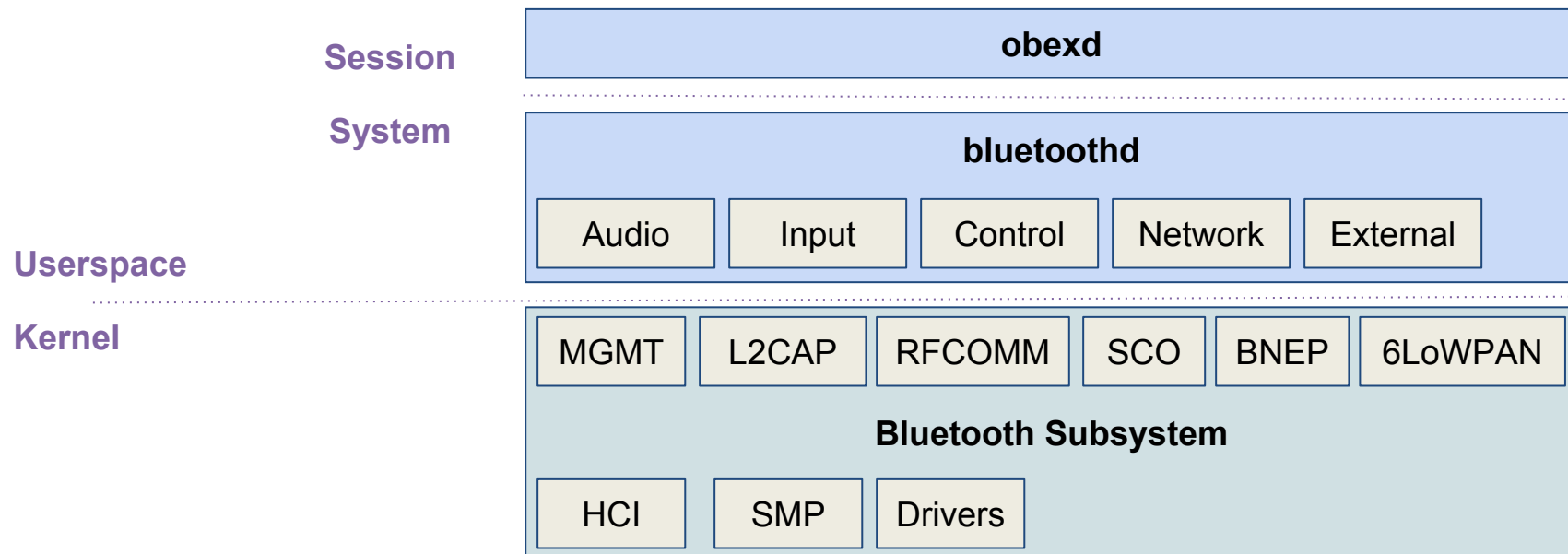


# BlueZ meets Zephyr

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# BlueZ - Linux Bluetooth



# Proxy

- `tools/btproxy`
- Use user-channel
- HCI UART proxying
- Local/Unix and TCP socket

# Monitoring

- HCI tracer
- Replaces hcidump
- Support multiple adapters
- Logs early commands including setup phase
- Support including logs such as syslog and crash backtrace
- Can monitor adapters connected to virtual machines
- Can monitor using a TTY

```
< HCI Command: LE Create Connection (0x08|0x000d) plen 25 14:24:06.255261
  Scan interval: 60.000 msec (0x0060)
  Scan window: 60.000 msec (0x0060)
  Filter policy: White list is not used (0x00)
  Peer address type: Public (0x00)
  Peer address: 00:1B:DC:07:31:88 (Vencer Co., Ltd.)
  Own address type: Public (0x00)
  Min connection interval: 50.00 msec (0x0028)
  Max connection interval: 70.00 msec (0x0038)
  Connection latency: 0x0000
  Supervision timeout: 420 msec (0x002a)
  Min connection length: 0.000 msec (0x0000)
  Max connection length: 0.000 msec (0x0000)
> HCI Event: Command Status (0x0f) plen 4 14:24:06.256227
  LE Create Connection (0x08|0x000d) ncmd 2
  Status: Success (0x00)
> HCI Event: LE Meta Event (0x3e) plen 19 14:24:06.393255
  LE Connection Complete (0x01)
  Status: Success (0x00)
  Handle: 3585
  Role: Master (0x00)
  Peer address type: Public (0x00)
  Peer address: 00:1B:DC:07:31:88 (Vencer Co., Ltd.)
  Connection interval: 70.00 msec (0x0038)
  Connection latency: 0.00 msec (0x0000)
  Supervision timeout: 420 msec (0x002a)
  Master clock accuracy: 0x00
< HCI Command: LE Read Remote Used Features (0x08|0x0016) plen 2 14:24:06.393405
  Handle: 3585
@ Device Connected: 00:1B:DC:07:31:88 (1) flags 0x0000
  02 01 06 11 07 95 e2 ed eb 1b a0 39 8a df 4b d3 .....9..K.
  8e 00 75 c8 a3 .....u..
> HCI Event: Command Status (0x0f) plen 4 14:24:06.394229
  LE Read Remote Used Features (0x08|0x0016) ncmd 1
  Status: Success (0x00)
< HCI Command: LE Remove Device From White List (0x08|0x0012) plen 7 14:24:06.394251
  Address type: Public (0x00)
  Address: 00:1B:DC:07:31:88 (Vencer Co., Ltd.)
> HCI Event: Command Complete (0x0e) plen 4 14:24:06.395211
  LE Remove Device From White List (0x08|0x0012) ncmd 1
  Status: Success (0x00)
< HCI Command: LE Set Scan Parameters (0x08|0x000b) plen 7 14:24:06.395230
  Type: Passive (0x00)
  Interval: 60.000 msec (0x0060)
  Window: 30.000 msec (0x0030)
  Own address type: Public (0x00)
  Filter policy: Accept all advertisement (0x00)
```

# Management

- Replaces hciconfig
- Low level interface - kernel
- Requires permissions
- Can tweak settings such as mode, etc.
- Changing settings may interfere with bluetoothd

# Controlling

- BlueZ command line tool client
- Replaces hcitool
- Can exercise most of the BlueZ APIs:
  - Scan
  - Advertise
  - Connect
  - Pair
  - Read/Write attributes
  - Enable notifications

```
[bluetooth]# connect 00:1B:DC:07:31:88
Attempting to connect to 00:1B:DC:07:31:88
[CHG] Device 00:1B:DC:07:31:88 Connected: yes
Connection successful
[NEW] Primary Service
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001
Eddystone Configuration Service
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0002
Capabilities
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0004
Active Slot
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0006
Advertising Interval
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0008
Radio Tx Power
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char000a
(Advanced) Advertised Tx Power
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char000c
Lock State
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char000e
Unlock
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0010
Public ECDH Key
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0012
EID Identity Key
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0014
ADV Slot Data
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0016
(Advanced) Factory reset
[NEW] Characteristic
/org/bluez/hci0/dev_00_1B_DC_07_31_88/service0001/char0018
(Advanced) Remain Connectable
[CHG] Device 00:1B:DC:07:31:88 UUIDs: a3c87500-bed3-4bdf-8a39-a01bebede295
[CHG] Device 00:1B:DC:07:31:88 ServicesResolved: yes
[CHG] Controller 7C:7A:91:18:82:46 Discovering: yes
[CHG] Controller 7C:7A:91:18:82:46 Discovering: no
```

# Zephyr Tests and Samples

- **tests/bluetooth:**
  - shell
  - tester
- **samples/bluetooth:**
  - beacon
  - central
  - eddystone
  - ipsp
  - peripheral\_{csc, dis, esp, hr, hids}

# Demos



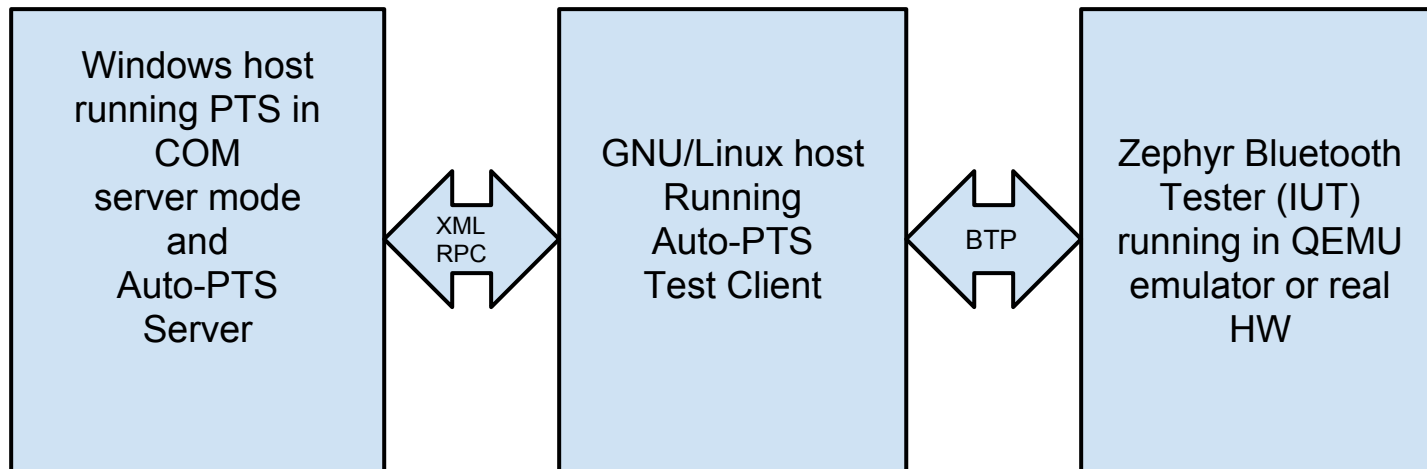
# Bluetooth PTS

- **Bluetooth Profile Tuning Suite:**
  - software-based black-box testing tool that automates protocol and profile interoperability testing.
- **Implements test specifications**
- **Mandatory for qualification**
- **Windows only**
- **Requires some level of expertise in order to execute tests with its user interface**
- **Newer versions support PTSTestControl COM API for extended automating**

# PTS automation architecture

- **server:** It is implemented in Python and executed using IronPython
- **client:** runs on GNU/Linux, communicates with the auto-pts server (to start/stop test cases, to send response to PTS inquiries) and communicates with the IUT (Implementation Under Test) to take appropriate actions. It is implemented in Python and executed using CPython.
- **Implementation Under Test (IUT):** It is the host running Zephyr Bluetooth stack to be tested, this could be an emulator or real hardware.
- **Bluetooth Test Protocol (BTP):** Used to communicate with the IUT.

# Architecture diagram



# Example test case

```
ZTestCase("GAP", "TC_DISC_NONM_BV_02_C",  
  [TestFunc(btp.core_reg_svc_gap),  
    TestFunc(btp.gap_read_ctrl_info),  
    TestFunc(btp.wrap, pts.update_pixit_param,  
              "GAP", "TSPX_bd_addr_iut",  
                btp.get_stored_bd_addr)]  
  TestFunc(btp.gap_adv_ind_on, start_wid=72)]),
```

# Current results

- **260 test cases automated:**
  - GAP 41
  - GATT client 76
  - GATT server 87
  - SM 34
  - L2CAP 22
- **Pass rate:**
  - PASS 248 (95.38%)
  - FAIL 5 (1.92%)
  - PTS ISSUE 7 (2.69%)

Questions?